

SCALE Training: SCALE Sensitivity and Uncertainty Analysis for Criticality Safety Assessment and Validation

Oak Ridge National Laboratory

Training summary:

This course provides fundamentals on sensitivity and uncertainty analysis methods and how to apply these methods to criticality safety validation applications. Topics covered include:

- The TSUNAMI sensitivity and uncertainty analysis techniques for determining the sensitivity of k_{eff} to cross section uncertainties, using both multigroup and continuous-energy physics.
- SCALE's comprehensive cross section covariance data library, which is applied together with the sensitivity coefficients to estimate the nuclear data-induced uncertainty in k_{eff} .
- The TSUNAMI-IP code, to determine the correlation between benchmark and application systems in terms of their shared sources of nuclear data-induced uncertainty.
- The VADER trending analysis tool, which uses similarity coefficients from TSUNAMI-IP (among other parameters) to estimate the computational bias and bias uncertainty for design and licensing applications.
- The TSURFER data adjustment tool, which uses generalized linear least squares to adjust nuclear data parameters to minimize discrepancies between computed predictions and the results of integral experiments; these adjustments can then be used to estimate bias and bias uncertainty in design and licensing applications.
- The TSAR code to compute sensitivities for reactivity differences based on k_{eff} sensitivity data determined with TSUNAMI, to highlight important processes that can lead to k_{eff} biases.
- The Sampler uncertainty quantification tool, which randomly samples input data - nuclear data and/or system parameters such as material compositions and dimensions - to quantify the effect of the uncertainties in these input data on the uncertainty in the system's k_{eff} .

This training course will cover the theoretical basis for these analysis methods and techniques and will also conduct exercises for attendees to familiarize themselves with these tools.

Note:

This training will be taught with SCALE 6.3. Previous experience with SCALE CSAS5 or CSAS6 criticality safety sequence is required.

Day 1

XXXXX
Welcome, Introductions, Logistics, Course Objectives
Overview of SCALE
CSAS review
Performing Validation
Introduction to TSUNAMI
XXXXX
Covariance Data for SCALE
TSUNAMI-1D Analysis Sequence
TSUNAMI-1D Workshop
Review TSUNAMI-1D Workshop
Direct Perturbation Calculations
Direct Perturbation Workshop

Day 2

XXXXX
Fulcrum Plotting of data and Sensitivities
TSUNAMI-3D Sequences
TSUNAMI-3D Class Exercise & Production Calculations

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TSUNAMI-3D Workshop

TSUNAMI-3D Workshop Review

Day 3

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TSUNAMI Validation Approach

Uncertainty Analysis, Correlation Coefficients, TSUNAMI-IP

TSUNAMI-IP Exercise Part 1

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Using Dice

Validation Gap Analysis with Demo

VADER

VADER Exercise for USL Determination

Day 4

XXXXXXTSURFER Data Adjustment with k_{eff} Data

Critical Experiment Correlations

TSURFER Exercise

TSAR for Reactivity Sensitivity Calculations

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TSUNAMI Users' Perspective

TSUNAMI Review
Sampler: Overview and Data Sampling
Sampler: Workshop 1 – Data Sampling
Sampler: Variables and Placeholders

Day 5

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Sampler: Workshop 2 – Compositions & Dimensions
Sampler: Parametric Calculations
Sampler: Workshop 3 – Parametric Studies
Wrap-up, Review, Open Discussion, Certificates